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SUBMARINE CABLE LAYING AND REPAIRING.

Submarine Cable Laying and Repairing. By H. D. Wilkinson, M.I.E.E. Pp. 401. (London: *The Electrician* Printing and Publishing Company, Ltd., 1896.)

THIS is not a scientific treatise on the electrical principles involved in submarine telegraphy; it covers, however, rather more ground than is set forth in the title, being also some sort of text-book for the electrician engaged in cable work. Mr. Wilkinson has treated his subject entirely from an up-to-date point of view, without attempting to show what has led to the present state of affairs, which, by the way, are the same—fundamentally speaking—as they were some thirty years ago. The method of working cables by machine transmission is not dealt with here; neither must the reader expect to find any matter relating to the duplex system of Messrs. Muirhead and Taylor, or that of others.

That portion which bears on construction might be more ample with advantage, especially as there are many engaged in submarine telegraphy who have never seen a cable made from start to finish. This remark particularly applies to the preparation and construction of the component parts of the insulated core, whether of gutta-percha (by Willoughby Smith's process or otherwise) or of vulcanised india-rubber, as well as of their collection in the state of nature. Much useful instruction is afforded with regard to the copper composing the conducting wire in a paper on electrical conductors, read by Mr. W. H. Preece, F.R.S., before the Institution of Civil Engineers in 1883.[1] Mr. Wilkinson has well, though briefly, described the constitution and application of the jute serving applied to the core of the iron sheathing, and of the outer covering, besides that of Bright and Clark's compound. The author has nothing to say on the subject of hempen cables, as suggested by Bullivant and afterwards by Trott and Hamilton. This silence is, however, justified by the fact that though a trial has been given to the latter in mid-Atlantic, the experiment has not culminated in further use. A cable without any iron armour appears, on the face of it, to be admirably adapted to recovery from great depths. The best quality of hemp decays, however, in salt water, even when by itself, to an extent sufficient to make the picking up of such a cable an almost impossible feat—not to mention the difficulties in the way of laying it down at a suitable angle.

No doubt Fig. 27 is intended to represent the ordinary close-sheathed type of the present day, but it rather suggests one of the alternate iron and hemp (low specific gravity) combinations, such as were once in vogue with a view to easy laying and recovery, but which, it is satisfactory to know, has long since been abandoned owing to its lack of durability.

Mr. Wilkinson gives us a strong chapter or two regarding submarine survey and sounding work, with good descriptions of the apparatus employed. At the present time, however, the line is supplied in lengths of as much as 7000 fathoms, thus rendering splices quite unnecessary in all depths so far dealt with. Nowadays, we also find that, provided a sinker is selected with sufficient weight for the depth, it will descend at a rate which will ensure the striking of bottom being readily observed. It is, therefore, no longer essential that the drum holding the wire should be particularly light; indeed, it is usually made of a sufficiently substantial character to permit of the wire being coiled direct on to it. Moreover, Lord Kelvin's plan of balancing the weight of wire outboard by weights added to the brake, has long since been abolished. The only proper method of preserving specimens of the bottom—partly for after-examination under a microscope—is to force the sample, *immediately* after recovery, direct from the "sounder" into an open glass tube, to be afterwards closed at both ends with corks, and hermetically sealed. The sample, when examined at any time, is then a true record of the bed of the ocean from whence it came. This plan was brought forward some years ago by Lieut. D. Wilson Barker, R.N.R. The water and mercury piezometers of Mr. J. Y. Buchanan come in for notice here. For a future edition, Mr. Wilkinson might find profit from a study of Mr. Buchanan's papers with reference to the various sounding and survey expeditions he has accompanied in H.M.S. *Challenger*, on the west coast of Africa and elsewhere. In this connection, the author and reader may also be recommended to peruse a paper, contributed by Lieut. Anthony Thomson, R.N.R., to the Sixth International Geographical Congress (1895), entitled "Remarks on ocean currents, and practical hints on the method of their observation." The importance of noting the nature, and measuring the strength, of deep-sea currents is better understood now than it used to be. It can, in fact, scarcely be over-estimated. In several instances of cables, past as well as present, much trouble and many repairs might have been saved had these matters been duly considered previous to laying. For further information regarding sounding work in its connection with submarine telegraphy, the reader should apply himself to a paper on the subject by Mr. Edward Stallibrass, in the *Journal* of the Society of Telegraph Engineers, 1887.

The various systems of landing shore ends under different conditions are all well set forth in this book; and, moreover, clearly illustrated.

Paying-out apparatus is gone into at some length. The cardinal principles, as first defined and put into practice, are closely identified with the names of Newall, Bright, Edwin Clark, Canning, Clifford, Appold, Amos, Siemens, Jenkin and Webb. The laws which govern the rate of paying out under given conditions are partially touched on in this treatise, though no reference is made to the heated controversy which arose in 1876 between Messrs. Longridge and Brooks, on the one hand, and the late Dr. Werner Siemens, on the other, as to whether the friction introduced by a body moving in fluid varied as the *square* of the velocity, or merely as the velocity. It is usually considered that the longitudinal coefficient is a result of something between the two, perhaps rather nearer to Dr. Siemens' theory.

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[1] *Mins. Proc.* Inst. C.E., vol. lxxv.

Mr. Wilkinson does not seem to be very clear as regards the waters in which teredoes may be expected. This is a question of temperature rather than of depth. Brass taping was first applied for this purpose to the core of some of the "Eastern Extension" Company's cables in 1879 by the Telegraph Construction Company; but it should be understood that this is only used for those types deposited in waters above a certain temperature. By bringing home picked-up cables, however, and laying them afterwards in another part of the world, the germs of the teredo and other boring nuisances sometimes present themselves in places where they had not previously appeared.

Mr. Wilkinson is evidently of opinion that you should find your cable before you make it, for he starts off with a goodly selection of the implements of war as regards the various forms of grapnels employed. To these he should add that of Mr. Henry Benest. As a cutting and holding grapnel, it has done admirable service.

Let us now turn to the electrician's side of the question. The electrical portion of the book is very complete as regards testing, and especially in methods of fault localisation; but it might be more so with reference to the apparatus. The new universal galvanometer of Mr. H. W. Sullivan, on the suspended coil principle, is well illustrated, but not quite correctly described. In the first place, unlike the Thomson marine galvanometer, there is no ironclad cover. Messrs. Weatherall and Clark's ingenious damping device for the "Marine" instrument is dealt with, showing how sensitiveness may be maintained though a suspension is made dead-beat. The principle and working of Varley slides are beautifully illustrated on p. 267, after the manner shown by Mr. W A. Price.[1]

Testing keys are dwelt on *ad infinitum*. With regard to the battery employed, surely Leclanché cells of any size, with an internal resistance of as much as 5 ohms, are unusual, if the cells are in good condition. Why does Mr. Wilkinson introduce the legal volt here? Surely in this class of work the old B.A. unit may be adhered to? For testing batteries, the author should remember that it is only Muirhead's method (and the modifications of Kempe and Munro) which are free from the objection of running down the battery during the test in such a way as to vary the E.M.F., and so give false impressions. Mr. Wilkinson describes a test of his own, on p. 223, for simultaneously testing the resistance and electro-motive force of a battery, which certainly looks hopeful.

In speaking of thirty seconds as a time allowance for making a "bridge test" during repairing work, it must be remembered that on anything like a long length of cable (and especially if partially coiled up), it takes a material time for the line to acquire its true potential throughout. This book gives a certain amount of information regarding the physical and electrical effect of temperature and pressure on gutta-percha, besides references to the present writer's contributions on the subject by way of explanation. It should be remembered, however, that, in selecting a type of core, the proportions are almost entirely governed by economical considerations for a given "K R" to effect a certain working speed with a limiting factor of safety from a mechanical standpoint.

With regard to the localisation of faults, Mr. Wilkinson gives us admirable accounts of the more recent methods of Sir Henry Mance, C.I.E., Mr. A. E. Kennelly, and others; besides the fall of potential test, due to Mr. Latimer Clark, with the special modification (for ship to shore work) of Mr. J. Rymer-Jones. The author does not, however, appear to show that in fault-testing a great number of observations should be made, besides various methods adopted for checking purposes; neither does he point out that no values should be used in after-calculations which appear, by comparison with the rest, to be untrustworthy. It is also advisable to discard results from one test which appear valueless by comparison with those obtained from the other methods adopted. No hard and fast rules can be made for fault-testing; much must be left to the individual judgment of the electrician according to prevailing conditions, character of fault, &c. Though a fault may have a low resistance, it is sometimes as variable as a high resistance fault; and, if so, it gives equal trouble to locate. One great point to be aimed at is, of course, to make the observations at the moment when the fault is least variable. With reference to Kennelly's break test, experience seems to show that the distance of the break from the testing station, in no way detracts from the value or efficiency of the test—notwithstanding Mr. Wilkinson's remarks. For other ways, however, it is well if the fault be fairly near. If the resistance up to the fault be great, then the battery power should be made in proportion, according to Ohm's law for a given required current. Mr. Wilkinson's limitation to the voltage employed in this test would, under certain conditions, be liable to materially reduce the value of the test from a point of accuracy. In a future edition the author should describe the reproduction method of taking Kennelly's test. It is in several ways preferable to working with the bridge, especially with a variable fault, as observations are made much quicker. Again, it involves the use of only one (dead-beat) galvanometer, thereby simplifying the carrying out of the test, besides reducing the chances of error. With Sullivan's galvanometer, this method, even on board ship, is found to give excellent results. Elsewhere in the book the author well describes and illustrates Mr. Willoughby Smith's ship and shore test during laying operations, besides the modification of the above, for fault-testing, as devised by Mr. H. A. Taylor.

The author also deals cursorily with land lines, describing the underground and beach systems of the Eastern Telegraph Company (as devised by Messrs. Clark, Forde, and Taylor), besides those of the present writer. Moreover, in this connection the Saunders and Bright Lightning Guards are respectively described.

Finally, so far as it goes, Mr. Wilkinson and the *Electrician* Printing and Publishing Company are to be congratulated on the above book as a treatise containing a vast amount of practical information in comparatively few words, such as are well adapted for study by the submarine telegraph engineer and electrician. The illustrations are admirable and almost entirely original. In the writer's opinion, the principal change required, before launching another edition, is a complete alteration of the order of the chapters, backed up, perhaps, by a slight amplification of the index.

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[1] "A Treatise on the Measurement of Electrical Resistance," by W. A. Price. (Clarendon Press, Oxford.)

Charles Bright.

THE HISTORY OF GEOGRAPHY.

The Dawn of Modern Geography. By C. R. Beazley. Pp. xvi + 532. (London: Murray, 1897.)

THE practical value of scientific geography has, during the last few years, become so evident to all classes, that the number of students of this fascinating subject has increased to an almost incredible extent, and the growing popularity of the Royal Geographical Society is a standing proof of the fact. The men who travel for the sake of duty or pleasure hasten to communicate to this body the results of their notes and observations, and their "papers" or books supply us with details, often most minute, of the remote countries and regions which we have for long considered to be inaccessible.

Supplied as we are with abundant information about the present conditions of the habitable globe, it is, perhaps, a little difficult for us to bear in mind how small were the beginnings of modern geography, and how little is known about them.

As the documents which formed the libraries and private property of individuals in Egypt and Western Asia become better known to us, we realise that a great caravan commerce was carried on between the peoples of countries which we have hitherto thought to have been entirely separated by impassable deserts and trackless mountains. But though we may recover the names of places by the score, we know nothing about them, and can only dimly guess at their positions; and we find trade or religion, or both, were the causes which induced men to move to any considerable distance from their native cities. Victorious armies brought home specimens of the animals and plants and trees from the countries whither they had marched, but their annalists tell us nothing of the situations of the scenes of their conquests.

The first to set down in writing in our own times a connected account of ancient geography was the late Sir Henry Bunbury; and now, following in his steps, Mr. Beazley has produced an interesting volume in which he has undertaken to trace the history of exploration and geographical science from the conversion of the Roman Empire to A.D. 900.

After the introduction come four chapters which describe the travels of pilgrims, merchants and missionaries; one chapter is devoted to the pseudo-science of the "Dark Ages," and another to Muslim and Chinese geography. The narrative is fully illustrated by a large series of reproductions of early maps. The revision of the whole of Chapter vi., on "Geographical Theory," together with Mr. Beazley's account of the history and use of mediæval maps for the whole book—although Mr. Beazley omits to state the fact—is due, we understand, to Mr. C. H. Coote, of the Map Department of the British Museum. Mr. Beazley could not have fallen into better hands, for Mr. Coote's experience in this branch of cartography is unrivalled.

Mr. Beazley's general sketch of the subject which he gives in his introduction is excellent; it is carefully done, and what is almost as good, there is an absence of "fine writing" throughout, which befits the work. He has read widely, and his remarks will form a useful guide to the early geographical literature of Europe, both in manuscript and print. When, however, he undertakes to discuss Oriental texts and literature, it at once becomes clear that he is only quoting at second-hand, and we feel that it is not his fault that he does not do full justice to the early Oriental missionaries. Whether there be historical evidence of the fact extant or not, it is quite certain that some of the Apostles and their immediate successors made their way into Armenia, Mesopotamia, Persia and the Far East. Already before the end of the second century of our era Bar-daisân, who was born at Edessa A.D. 134 or 154, became a Christian missionary in Armenia, and he wrote polemical treatises against the polytheism of the heathen. Before the end of the third century Mâr Mattai had founded his famous convent on Jebel Maklûb near Nineveh, and there is proof that several other religious houses existed in the neighbourhood at this period.

From a passage in "Arnobius" (ed. Leyden, 1651, lib. ii, p. 50) it is pretty clear that Christians existed in the Seres (China), Persia and India; and if this be so, which there is no good reason to doubt, many missionaries must have travelled over the country between Palestine and China, or at least voyaged to the latter country by sea. Early in the fourth century Mâr Awgîn set out for the East with seventy disciples, and founded a great religious house near Nisibis, and about 363 A.D., with Sapor's consent, he sent out seventy-two missionaries to found monasteries in Shiraz and Huzistan. A century later Christianity had extended along the shores of the Persian Gulf as far as the Island of Bahrên,, and the Gospel had been preached by Nestorian missionaries in the south of the Arabian peninsula.

The monastic history of Thomas of Marga would have supplied a number of important facts bearing on the early travels of monks who went from the East to visit the Scete desert and Palestine, and Assemani's dissertation in "Bibl. Orientalis" would have given Mr. Beazley many more. As to the genuineness of the Singanfu bilingual inscription there is no doubt whatever, and we may remark that the Patriarch Ḥĕnân-Îshô' II. died in 780, and not in 778, as we are told on p. 217, note 3; the first Nestorian bishop was consecrated in China in the seventh century. All these are, however, matters which Mr. Beazley may put right in a second edition; and we hope that some attempt will be made to alter barbarisms like "Jesu Jabus" (p. 213), "Anan-Yeschouah" (p. 217), and "Massoudy" (p. 458), &c. And why does Mr. Beazley hesitate to identify "Doul-Karnain" with Alexander the Great? Alexander claimed Ammon of Egypt as father, and a well-known title of this god is "provided with two horns," a phrase literally translated by the Arabic "Dhu'l karnên."

We gather from a footnote that Mr. Beazley intends to continue this "History of Modern Geography"; and if this be so, we shall welcome a further contribution to the literature of this important subject by so able a writer. In conclusion, we cannot help remarking that the index is so small as to be almost useless.